TENT CATERPILLAR Evaluation

Action		Initial
	ARF	
	Sales	
	Adm.	
	App. Study	
	RA	
	Reforest.	
	BD-EC	
	Plans	
	M Plans	
	Invent.	
	Ins. & Dis.	
	D&E	WK
	1	
	2	CKL
	3	
	4	
	D&E Boise	
	Control	
	1	
	2	
	3	
	Pathologist	
	Clerk	

FORM 6200-8 (1/64)

UNITED STATES GOVERNMENT Department of Agriculture—Forest Service

Memorandum

TO : The Record

File No. 5230

FROM : Donald J. Curtis, Entomologist

Date: June 2, 1966

SUBJECT: Evaluation

Your reference:

Introduction

For more than 30 years a tent caterpillar has been reported on Fremont poplar at Zion National Park and other areas of host distribution in Southern Utah. During the past 15 years, control efforts have been carried on against this pest in Zion National Park.

During this period the National Park Service, with technical assistance from the Forest Service has constantly worked toward improvement of a control effort through more efficient methods of application and more suitable insecticides. Unfortunately, no thoroughly reliable sampling procedures for use in obtaining information necessary for predicting population trends have even been developed and can be considered virtually nonexistent.3/

With the objective of obtaining necessary biological information for making reliable predictions concerning population fluctuations and for planning future control projects, a preliminary survey was conducted at Zion National Park during the first week of March 1966.

In order to obtain a maximum amount of information in the limited time available, it was felt that the investigation should be directed toward the life stage of the insect biologically most stable so that a maximum amount of information could be obtained for a given amount of effort.

Life Stage Sampled

The egg stage was chosen because information was needed concerning oviposition sites; because it would be easy to sample and because almost 11 months of the single generation per year is spent in this stage. Also, it was hoped that the eggs could be used to yield information about parasitism, potential members of caterpillars available for defoliation.

3/ Two egg mass sampling techniques have been developed for predicting defoliation to Quaking Aspen (Populus tremuloides). One for the forest tent caterpillar (Malacosoma disstria Hbn.) in Canada by R. F. Shepard and the other for the great basin tent caterpillar (Malacosoma fragile stretch) in New Mexico by the Albuquerque Insect Laboratory.

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and actual numbers of caterpillars emerging under given conditions. In addition, the eggs could be used to provide a source of laboratory insects needed for related information concerning larvae size, length of time for instar development, length of pupation and mating and flight habits.

Sample Area

The area chosen for sampling individual trees contains an abundant amount of infested Fremont poplar scattered throughout a large campground, around a visitor's center and along the Virgin River. This sampling area extends from the Park boundary north of Springdale, Utah, along the Virgin River to about one mile northeast of the Park Headquarters building.

Sample Units

The individual trees were chosen because they were accessible and because they contained a large number of recognizable old tents. Because of the uniformity of the trees within the area, they are assumed to be typical trees and representative sampling units.

Each tree was numbered, marked with yellow flagging and a $2\frac{1}{2}$"x $1\frac{1}{2}$" white card and plotted on a sketch map for easy reference. In addition, a brief description was written concerning tree size, crown level and location.

Sampling Procedure

Five branches were cut from the mid-crown of 13 trees with a pole pruner. The length and diameter of each branch was measured and the total number of new and old egg masses were recorded. In addition, a 30 inch sample was cut from the "tip" portion of the original sample. The number of new and old egg masses, were then recorded for comparison with the original.

The field samples were put in individually marked bags, sealed and taken to Ogden and placed in refrigeration until additional measurements could be made.

Lengths and diameters of all twigs with attached egg masses were measured. The distance from the bud to the lower end of each egg mass and, also the diameters at the mid-point of each mass was determined.

In addition, 50 egg masses were incubated to determine numbers of emerging larvae and numbers and kinds of egg parasites. These same masses were shaved with a razor blade to remove the spumaline coating and then examined under a 10 power binocular microscope to determine the total number of eggs per mass.

The results of these measurements, along with data concerning branch sample comparisons, length of pupation, sex ratio and parasite and virus mortality, are listed in the summary. Some calculations and laboratory measurements are listed in the following tables and charts.

Table 1

Comparison of the Average Number of Egg Masses/Branch for Five Foot Branch and 30" Branch By Tree

Tree No.	5' Sample		30" Sample	
	New	Old	New	Old
1	4.4	3.2	1.8	1.0
2	9.6	1.4	2.4	-
3	2.4	0.2	0.6	0.2
4	9.4	4.6	3.4	0.6
5	4.8	1.4	2.2	-
6	2.4	0.8	0.2	0.2
7	-	-	-	-
8	-	-	-	-
9	1.0	0.2	1.0	0.2
10	6.0	3.6	2.2	0.6
11	1.5	2.5	0.4	-
12	1.6	1.4	1.4	0.8
13	1.6	2.6	1.2	1.0

Table 2

Larval Emergence, Number of Eggs Per Mass, and Egg Mass Dimension

	Larval Emergence	Number Eggs/Mass	Egg Mass Size
Mass	No. of Larvae	No. of Eggs	Length & Width in mm
1	93	138	10.6 - 6.8
2	128	186	11.4 - 6.6
3	115	122	13.4 - 5.8
4	62	207	12.0 - 6.8
5	131	149	14.0 - 5.8
6	79	168	11.2 - 7.8
7	82	144	10.2 - 8.0
8	96	171	12.0 - 6.8
9	68	157	13.0 - 6.4
10	100	117	11.4 - 7.8
11	199	98	11.6 - 8.4

Continued

	Larval Emergence	Number Eggs/Mass	Egg Mass Size
Mass	No. of Larvae	No. of Eggs	Length & Width in mm
12	69	160	13.8 - 8.6
13	66	158	11.6 - 8.4
14	109	123	14.4 - 6.2
15	72	166	10.8 - 9.2
16	106	167	11.2 - 6.4
17	91	157	10.2 - 5.8
18	91	193	10.0 - 4.2
19	61	142	9.6 - 6.2
20	52	137	12.2 - 9.4
21	97	121	11.8 - 6.8
22	135	152	11.2 - 8.0
23	95	167	13.0 - 7.8
24	116	145	12.0 - 9.0
25	71	117	11.4 - 7.0
26	114	120	10.6 - 7.8
27	138	130	11.0 - 8.0
28	130	167	14.8 - 7.4
29	121	130	13.0 - 7.0
30	120	187	13.2 - 7.0
31	62	188	17.0 - 9.2
32	65	187	12.4 - 9.0
33	103	195	11.4 - 8.0
34	116	89	13.2 - 8.0
35	145	102	13.0 - 7.0
36	50	90	12.6 - 5.4
37	73	187	11.4 - 8.4
38	106	129	14.0 - 8.8
39	52	187	14.4 - 7.0
40	133	154	12.2 - 6.2
41	128	123	15.2 - 7.6
42	104	144	14.2 - 8.6
43	107	68	15.4 - 9.2
44	134	192	11.0 - 7.4
45	52	69	12.0 - 6.2
46	98	116	11.0 - 7.8
47	107		12.0 - 6.4
48	123		8.6 - 7.4
49	109		12.6 - 8.6
50	119		9.0 - 6.4
Average	100	146	Length = 12.2 Width = 9.0

Mean and Standard Deviation for Length and Diameter Measurements
*Three Standard Deviations

Diameter measurements = X

$Ex = 1,137$

$(Ex)^2 = 1,292,759$

$Ex^2 = 6,211.84$

$n = 232$

$\frac{(Ex)^2}{n} = 5,572.24$

$EX^2 \frac{-(Ex)^2}{n} = 539.60$

mean x $(\bar{x}) = 4.91$ mm

$\frac{Ex^2 \frac{-(Ex)^2}{n}}{n-1} = 2.249 = S^2$

Standard deviation = $\pm$ 1.5 mm

Coefficient of variable = 31%

Sampling errors = .098

* 99.7% of egg masses will be found from diameter sizes. .41 mm --- 9.41 mm

Length Measurements = y

$Ey = 1,657.15$

$(Ey)^2 = 2,746,146.12$

$Ey^2 = 16,829.83$

$n = 232$

$\frac{(Ey)^2}{n} = 11,837.22$

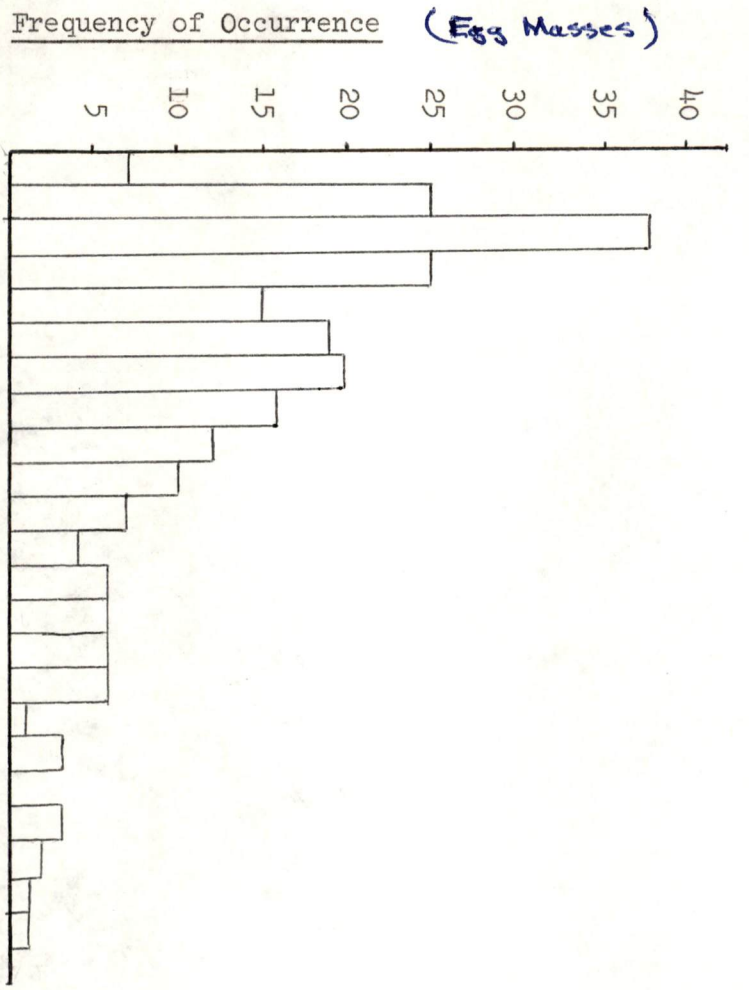
$Ey^2 \frac{-(Ey)^2}{n} = 4,992.61$

mean y $(\bar{y}) = 7.14$ inches

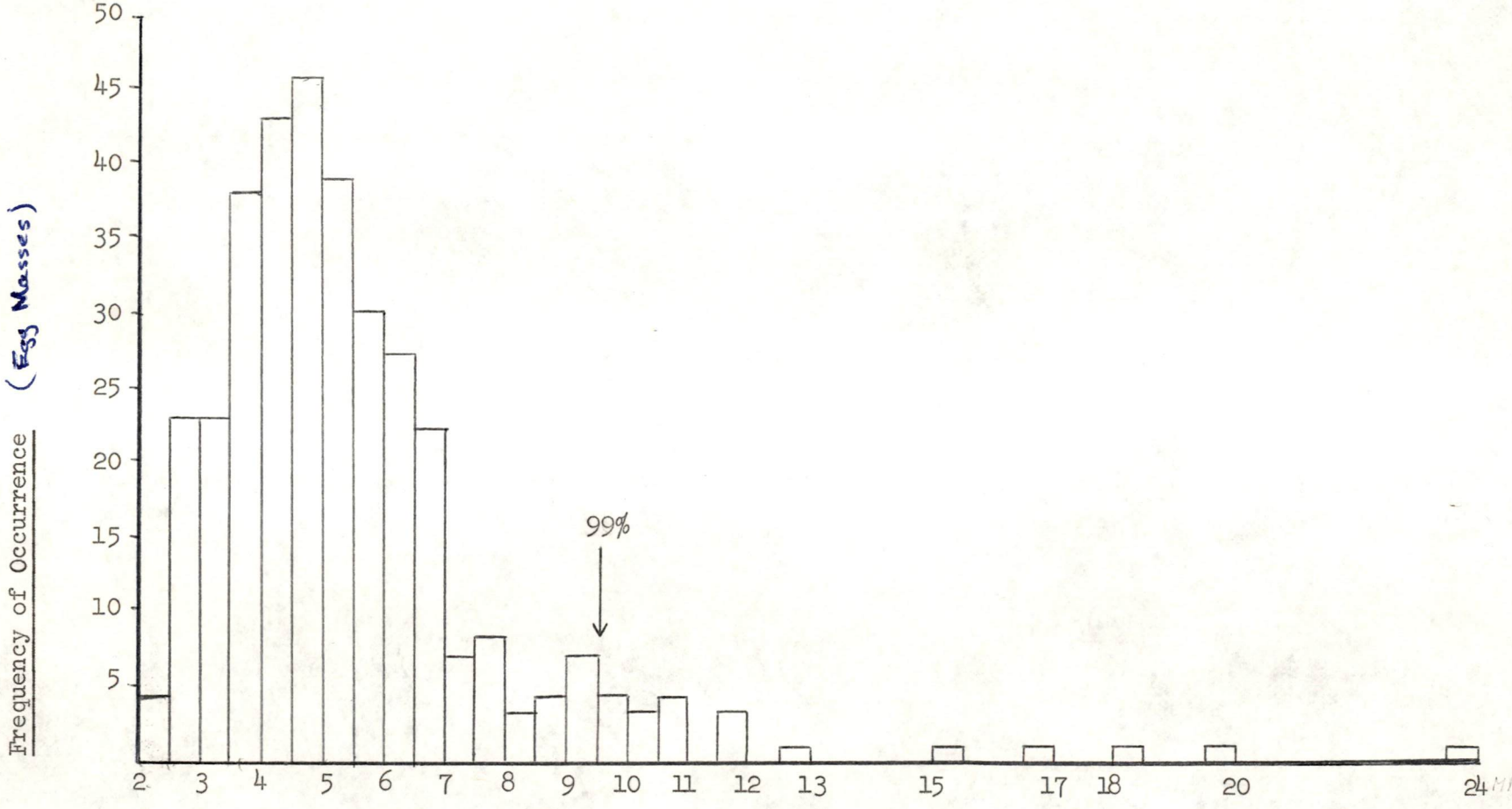
$\frac{Ey^2 \frac{-(Ey)^2}{n}}{n-1} = 21.61 = S^2$

(S) Standard deviation = $\pm$ 4.65 inches

* 99.7% of the egg masses will be found on twigs from .25 to 21 inches long.



Distribution of Diameters by 1 Inch Classes



Location of Egg Masses on Twigs by 0.5 mm Diameter Classes

Diameters of twigs on which egg masses were found in millimeters.

Results

A summary of preliminary investigation concerning a tent caterpillar, Malacosoma incurvum discoloratum, 1/ causing defoliation on Fremont poplar (Populas Fremontii) at Zion National Park and other areas of host distribution in Southern Utah conducted during the week of 1-4 March 1966, is as follows:

Oviposition Site

Diameter of twigs in mid-crown position at oviposition site range from 2-24 mm. The average diameter size at which oviposition occurs is 4.91mm. With a computed standard deviation of ± 1.5 mm, 99 percent of the egg masses will probably be found on diameters not larger than 10 mm (Three SD = 9.41 mm).

The range of distances from the bud end of twigs on which oviposition occurs is .25 - 23.25 inches. The average distance from twig endings at which oviposition occurs is 7.14 inches. With a computed standard deviation of ± 4.65 inches, 99 percent of the egg masses will probably be found no farther from the bud end of the twig than 21 inches (Three SD = 21.09 inches).

Egg Mass Size

A random sample of 50 egg masses collected from Zion National Park were measured. These masses were found to have an average length of 12.2 mm and a width of 9.0 mm.

Larval Emergence and Number of Eggs per Mass

Incubation of the 50 measured egg masses resulted in an average emergence of 100 larvae. Disection of 46 of the same 50 egg masses and examination under a 10 power binocular microscope revealed that each mass actually contained an average of 146 egg capsules.

1/ Redescribed by Dr. F. W. Stehr, was previously called the Great Basin Tent Caterpillar, Malacosoma fragile stretch.

Length of Pupation and Sex Ratio

Larvae of the same species of caterpillar were collected near St. George, Utah and reared to pupation in the laboratory at Ogden. On April 18, 1966, 298 selected larvae began pupation and completed pupation on April 20, 1966. These pupae were kept at 80 percent humidity and 86°F. daytime temperature and a 60 percent humidity and 60°F. nighttime temperature, both with a constant light source, until emergence on the 4th of May. Only 237 of the 298 larvae completed pupation and emerged as adults at the end of the 14 days. The 128 males and 109 females, roughly, result in a sex ratio of 1:1.

Mortality Caused by Virus and Parasitism

The 61 dead pupae may have been a result of a nuclear polyhedrosis virus. Nearly 39 percent of the tent caterpillar colonies examined on desert almond in the St. George area of Southern Utah had symptoms of virus infection. Colonies on Fremont poplar were also heavily infected with virus. 2/ In 1965, tent caterpillar populations were reported to be dying from a virus infection in Bryce National Park. This condition, however, has not been seen by Forest Service entomologists or been reported by Rangers or Naturalists at Zion National Park.

Five adult hymenoptera parasites emerged 10 days after the last tent caterpillar larvae emergence andwwere sent to the ARS, Entomology, Research Division, Beltsville, Maryland for positive identification. All egg masses examined in Ogden contained numerous dead hymenopterous parasites. Parasite occurrence was quite variable, ranging from a high of 70 to a low of 13 individuals per mass. Average mortality presumably caused by this parasite was calculated at about 22 percent. This, roughly, amounts to the difference between the number of eggs per mass and the number of larvae that emerged.

Branch Sample Comparison

A comparison of the number of old and new egg masses was made between the 5 foot and the 30 inch branch samples. As can be seen from Table 1, the 30 inch sample gives a poor estimate of the number of egg masses found on the 5 foot branch.

Before deciding on a definite sized sample, it would be prudent to sample the lower and upper crown levels of Fremont poplar. A comparison could then be made to determine if intratree differences in oviposition preference and population levels actually exist.

2/ McGregor and Sandin, field evaluation, Southern Utah, 13-14 April 1966

Conclusions

The purpose of this investigation was to acquire basic biological data necessary for the development of statistically reliable sampling techniques to measure tent caterpillar populations.

To accomplish this end, the different crown levels must be sampled. Only after this has been done and comparisons made between the resultant sets of data, can we begin to construct sampling techniques for making population predictions.

To supplement this needed information, one should determine the precise way in which these insects are able to move from tree to tree. At best it is only a guess as to whether these insects fly, crawl or are carried by wind as they disperse.

In addition, a correlation will have to be established between the number of egg masses per sampling unit and the degree of defoliation that will result.

The possibility of introducing a nuclear polyhedrosis virus into disease-free infestations should be considered. This might be done under the auspices of a joint research administrative effort. It would be an opportunity for research to further its knowledge about virus and, if successful, would result in an inexpensive long-term control of a noxious insect.

Donald J Curtis